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coronoid process, and not extending anterior to the line of the posterior margin of the tubercular molar. Ramus narrow at first premolar.

	In.	Lin.
Length of ramus from posterior margin canine to do. of tubercular.....	1	5.5
“ to posterior margin sectorial.....	1	3
“ third premolar.....		3.75
“ sectorial molar.....		6
Width of same (posterior lobe) ..		2.8
Depth ramus at posterior margin first premolar.....		7.5
“ “ “ sectorial.....		8.25
Width “ “ symphysis.....		4.5

This species appears to have been perhaps rather larger than the *Galera barbata* (Gray) of Brazil, and of a rather more slender muzzle. As compared with that species, it exhibits many peculiarities. The third premolar is smaller, and the first, the sectorial, and the tubercular relatively larger. In *G. barbata* the first molar has but one root, and the mandibular ramus thicker and deeper. The masseteric ridge advances to opposite the middle of the sectorial molar, and is continued on the inferior margin of the ramus, much anterior to its position in the *G. macrodon*.

The discovery of this species adds another link to the evidence in favor of the extension of neotropical types\* over the nearctic region during the post-pliocene epoch. Of thirty continental North American species enumerated by Leidy (Ancient Fauna of Nebraska, 9), all but thirteen may be said to be characteristic of that, or closely allied to the species of the present period of North America. Of the thirteen, one (*Elephas*) is characteristic of the old world, of one (*Anomodon*) affinities unknown, and eleven are represented by members of the same family or genus now living in South America.

Among marine vertebrata, as among molluscs, the equivalency with the European beds of the same age is much closer. The following parallels exhibit this relation:

<i>North American.</i>	<i>European.</i>
<i>Aëtobatis arcuatus</i> ,	<i>Aëtobatis arcuatus</i> ,
<i>Myliobatis pachyodon</i> ,	<i>Myliobatis reglianus</i> ,
<i>Raja dux</i> ,	<i>Raja ornata</i> ,
<i>Plagiostomi</i> sp.,	<i>Plagiostomi</i> sp.,
<i>Priscodelphinus grandævus</i> ,	<i>Priscodelph. canaliculatus</i> ,
<i>Balæna palæatlantica</i> ,	? <i>Balæna lamanoni</i> ,
<i>Squalodon mento</i> ,	<i>Squalodon grateloupii</i> ,
<i>Squalodon atlanticus</i> ,	<i>Squalodon antverpiensis</i> .

#### On the genera of Fresh-water Fishes *HYPHILEPIS* Baird and *PHOTOGENIS* Cope, their species and distribution.

BY E. D. COPE.

The two genera in question are among those represented by the greatest number of individuals in the streams of the eastern district (*i. e.*, east of the Rocky Mountains) of our continent. *Hypsilepis* is distributed over the greater part of this area, while *Photogenis* abounds most in the Allegheny region, and always in the streams flowing through the Mississippi valley, as no species is known to occur in an Atlantic water. As we proceed northwards, the latter genus disappears with many others, one after another, while *Hypsilepis* still remains, and with its largest forms peoples the waters of the Great Lakes and the St. Lawrence.

\* The genus *Galera*, Gray, is here regarded as distinct from *Galeitis* Bell (*Grisonia* Gray), as it possesses an internal tubercle on the inferior sectorial, which is wanting in the latter.

The food of both genera consists of insects, though *Photogenis* only has the pharyngeal teeth without grinding surface. In the latter genus the dorsal fin is above the ventrals; in *Hypsilepis* it varies from a little anterior to considerably posterior. The large scales of the lateral line in *Hypsilepis* are so extensively imbricate as to leave but a narrow margin exposed, giving a character and name peculiar to the genus. Teeth in the longer row in both 4—4.

#### HYPSILEPIS Baird.

This genus was first outlined by Prof. Agassiz, in his work on Lake Superior; it was then partially defined by Dr. Storer in his *Fresh-water Fishes of Massachusetts*, and later more fully by Girard, *Pr. A. N. Sci.* 1856. Girard has enumerated the species, which are here reviewed with the exception of two,—viz.: *H. obesus* (*Leuciscus* Storer), from Alabama, and *H. gracilis* (*Leuciscus* Agass.) These are described in such an imperfect manner as to leave no alternative but to omit them from this essay.

There are two coloration types in the genus, one where the species are adorned with red pigment (Sections I. and III.), and (Sect. II.) where a white pigment is deposited. These are most brilliant during the season of deposit of eggs, and vanish in some species later in the season. In the *H. coccogenis* much of the brilliant coloration remains throughout the whole year. There are few sights more pleasing than the brilliant crimsons of these fishes rapidly reflected in the pure water of the mountain streams, especially where species of other genera, as *Clinostomus*, *Chrosomus* and *Argyreus* vary the hues with gold and black. These are as the bright birds to the forest, or flowers to the field, in the otherwise monotonous life of the waters.

Section III. approximates *Alburnellus* in the position of its dorsal fin. In Section II. *H. analostanus* occasionally exhibits masticatory surface on two or even on one tooth only, thus approximating *Cyprinella* Girard. The *Cyprinella cercostigma* Cope is of much the same type, but is without this surface, indicating the close approximation of the two genera. This species may be established as follows, prefatory to an examination of the true *Hypsilepis*:

*Cyprinella cercostigma* Cope, sp. nov.

Teeth 2·4—4·2, with sharp, serrate edges. Dorsal fin inserted two scales behind that above insertions of ventrals. Dorsal line compressed elevated, rising regularly from end muzzle. Cranium convex above; muzzle narrowed in profile, slightly overhanging mouth. Eye 4·33 in length of head, 1·5 in length muzzle, and 2 in interorbital width. End maxillary opposite posterior margin nares. Ventral outline less curved than dorsal; caudal peduncle rather stout; isthmus narrow. Scales rather elevated, 8—39—3. Lateral line gently decurved over ventrals.

Head 5·25 times in total length (4·25 to origin caudal), one scale less than depth at dorsal. The pectorals nearly reach the ventrals, and the latter attain the vent. Radii A I. 8. C. + 19 + A. I. 8, the longest ray  $\frac{4}{3}$  its base, and  $\frac{3}{2}$  distance to longest fulcrum at origin caudal. Total length 4·52 inches; depth ·95 inch.

Color bright olive above, without line or spot; below and sides from fifth lateral row of scales above, golden silvery. All the fins except the pectorals with white pigment at their bases, without markings; a large round black spot at base of caudal.

*Habitat*—Pearl River, Mississippi, at Monticello. Helen Tennison's coll. in Mus. Smithsonian, Washington, D. C. Four specimens.

- I. Dorsal fin above or anterior to ventrals; teeth 2·4—4·2;  
anal radii I. 9.

Head more elevated, decurved above, mandible included; mouth slightly oblique; eye over four times in length of head. Dorsal and caudal neither black nor yellow-banded..... cornutus.

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Head nearly plane above; mandible projecting beyond muzzle, mouth very oblique; eye less than four times in head. Dorsal black bordered; caudal yellow at base; head red striped... coccogenis.

II. Dorsal fin a little behind above ventrals; teeth 1·4—4·1; anal radii (usually) I. 8.

Head flat, descending, mandible included, mouth horizontal; eye nearly five times in head. Dorsal with a black spot behind; caudal yellow at base, head not striped; teeth smooth; larger galacturus.

Similar to the last, but smaller; the teeth more or less crenate, and the basal half of the caudal fin is not colored; a black scapular band ..... analostanus.

III. Dorsal fin well behind above ventrals; teeth 2·4—4·2; anal radii I. 11.

Head short, deep, eye entering 3·5 times; small, depth 3·75 in length; lateral line much decurved, scales 10—44—3, not black-edged; dorsal black at base..... diplæmia

Head flat, elongate; mouth very oblique; eye three and a-half times in head; small, depth one-fifth length without caudal; scales black-edged above 9—50—3. Dorsal black at base; lateral line little decurved..... ardens.

#### HYPHILEPIS CORNUTUS Mitchell.

Girard, in Storer, Trans. Amer. Acad. Arts Sciences v. 1855, 118. Proc. A. N. Sci. Phila. 1856, 212. *Cyprinus* Mitch., Amer. Month. Magaz. N. Y. I. 324. *Leuciscus cornutus* Storer, De Kay.

This is one of the most widely distributed of our Cyprinidæ, occurring from Nova Scotia and New England through the middle and western States to beyond the Mississippi, and in the Roanoke and Tennessee Rivers southwards. In the waters of the Susquehanna and Delaware basins it is, with the *Argyrenasus*, the most abundant species. It prefers clear waters, and does not haunt rapids.

The best figure of this, as well as of some of our other Cyprinidæ, is given by Dr. Storer in his excellent Monograph on the fishes of Massachusetts.

This species is represented in its distribution by a greater amount of variation than any other of the family with which I am acquainted. The varieties are constant in a great number of their individuals. They may be enumerated as follows:

H. c. gibbus, Proc. Acad. 1864, 279.

Seven specimens from Monroe county, Mich. Scales large, six rows above lateral line, sixteen anterior to dorsal fin; it differs from the following in the great elevation of the outline in front of the dorsal fin, and other points. From the first dorsal ray the outline again descends, giving the fin a very oblique position; this extends also, when laid back, as far as above the fifth anal ray, while in *frontalis* it most usually reaches a point opposite the first ray only. The eye is contained four times in the length of the head—more frequently four and a half times in *frontalis*. The length of the head measures in the depth of the body, from the dorsal outline to the middle of the row below that bearing the lateral line; it extends nearly to the ventral outline in *frontalis*. The pharyngeal bones appear to be relatively rather stouter than in typical *frontalis*, and are not furnished with so prominent an inferior angle to the external ala. This, with the form of the body, would almost indicate a species; but as I find approximations in these and transitions in the other characters, I cannot so consider it.

H. c. *frontalis*. *Leuciscus frontalis* Agassiz, Lake Superior, p. 368. *Hypsilepis frontalis* Cope, l. c. 279.

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Scales of dorsal region larger; fifteen to eighteen in front of dorsal, six above lateral line. From various streams flowing into Lakes Huron and St. Clair. Lake Superior, Agass. Holston River, Virginia, abundant. Orbit in specimens 3 in. 9 l. in length, 3.5 times in head; in specimen 7 in. 3 l., 4.75 times in head. The latter have the interorbital region arched in section, and the vertical diameter of the orbit 3.74 in the same of the head. The former, the interorbital region flat and the orbit twice in the head as before. The large specimens have a black scapular bar. They all belong to one variety.

*H. c. cerasinus.*

This variety is represented by specimens of rather small size, and with large scales: 6—40—3; 16 in front of dorsal fin; orbit 3.25 in head of a specimen 3 in. 9 l. in length. Head four times in length. This is a most beautiful species in the spring and summer; it is entirely deep rose, the inferior fins crimson, a dorsal and two lateral metallic golden lines; the latter only visible in life and in certain lights, as in the other varieties. Head waters of the Roanoke.

*H. c. cornutus.* *Leuciscus cornutus* Mitchell. *Leuciscus plargyrus* Rafinesque hinc *Plargyrus typicus* Girard. *Plargyrus bowmanii* Girard, Proc. Acad. 1856, 196 (from autopsy).

Scales of dorsal region smaller, 22 to 24 in front of dorsal fin; on sides 8—41—3—4. Dorsal region blue in spring; fins, chin and muzzle red. Dorsal region convex and compressed to dorsal fin, the head four and one-quarter times in length to base of caudal fin, and four-fifths of greatest depth of body; vertex concave, muzzle obtuse rounded; mouth terminal, end of maxillary terminating opposite posterior nostril. From end muzzle to dorsal (1st ray)  $\frac{7}{8}$ ths from latter to origin of caudal. Ventrals origin exactly under first dorsal, broadly truncate, not quite attaining vent. Base of anal nearly equal its anterior ray, outline slightly concave. Base of dorsal two-thirds height anteriorly. Pectoral anterior rays shortened, medial not quite reaching the ventral. Operculum one-third higher than long. Eye, diameter one-fourth length of head, and once below its rim to upper preopercular ridge. Frontal width one-half length head above. Scales  $\frac{8}{41}$ , about twenty-three on the dorsal line in front of third dorsal fin. Radial formula D. 1. 8; C. 4. 19. 5. A. 1. 9. V. 8; P. 1. 15. Coloration of an adult male: dorsal region as far down as the fourth row of scales dark impure blue, divided by an indistinct band of yellowish-olive one and a-half scales wide, which follows the outline of the back; bordering the dark below is a luminous line which does not attain the tail, which is very visible in the water, and from above when wet and out of water. Sides from rosy to silver-white, the scales in adults blackish at bases; anal, ventral and pectoral fins bright crimson in spring and summer, in males. Operculum rosy, head dark above. The males in spring have the branchiostegal membranes and the chin bright crimson.

Total average length 5 in. 7 lin.; head 1 in. 1 l.; end muzzle to base anal 3 in.; depth at dorsal 1 in. 4 l.; at anal 11.5 l.

The above description is taken from an adult from the Conestoga in Pennsylvania, tributary to the Susquehanna. It applies equally well to all individuals of the species, except as pointed out under the heads of the varieties, respectively. Nevertheless, the specimens from the Susquehanna are frequently distinguishable from those of the Delaware. Numerous specimens from Michigan agree with the former in having a more elongate form of head and body than specimens from tributaries of the Delaware. They often differ from those of the Susquehanna in having a row of scales more below the lateral line. In Delaware specimens the head is shorter than in the latter, not more so than in the former, but the depth of the body is greater than in either, entering in length to base of tail  $3\frac{1}{2}$  times—in the others 4 and  $4\frac{1}{2}$  times. The dorsal fin is a little more anteriorly situated in the Delaware specimens, and there is a row of scales more below the lateral line than in Susquehanna specimens. 1867.]

mens. With typical specimens only, these might be regarded as representing two species, and as such I have already alluded to them; but in the large number of individuals at my disposal, I find transitions in all the points. The Delaware specimens more nearly resemble the *H. cornutus*, figured by Dr. Storer.

*General Habitat*.—Eastern, Middle and Western States; head waters of the James River. There is nothing in the description of *Plargyrus argentatus* Girard (l. c. 212), from the lower James River, to distinguish it from this variety.

*H. c. cyaneus*.

Scales of the whole dorsal and ventral regions very small, 31 to 40 in front of dorsal fin; on sides 10—40—4. Colors very dark; above blackish-blue, all the scales black at their bases; head entirely black; pectorals black: ventrals with a broad black band and red tip; anal black in front, dorsal chiefly black; membrane of caudal blackish. In a specimen 5 in. 10.5 lines long, the orbit enters the head 4.5 times. Small tubercles extend from muzzle to vertex, are numerous on the sides of the former to rictus oris, and form a strong crest on mandibular and suborbital bones.

This well-marked variety was taken in the Montreal River, Keeweenaw Point, on Lake Superior, by John H. Slack, M. D., to whom the Academy is indebted for a number of specimens.

#### *HYPSILEPIS COCCOGENIS* Cope.

*Spec. nov.*

The general form of this fish is moderately stout, the head elongate and straight, with large eye. The caudal peduncle is neither narrow nor broad; the dorsal outline very little elevated. Length of head four and a quarter times in total without caudal fin; greatest depth scarcely less than length of head. Diameter of eye three-fourths of frontal width, and greater than distance between its lower margin and gular plane. Scales of typical form 7—42—3. The fins rather small; pectorals extend little more than half way to ventrals, and the latter do not reach the vent. External margin of anal as long as from end of muzzle to preopercular line, or as long as pectoral; front margin of dorsal equal the same, and greater than posterior margin of same.

The colors of this fish are very pleasing. Belly and sides silver white, or in the breeding season rose-colored, bounded above the lateral line by a leaden shade. Back olive, with sometimes a brown dorsal band, sometimes the scales heavily black margined. The head blackish above, and a deep black band on the scapular arch. Muzzle and lips with a broad band behind the edge of the preoperculum and axillary spot, crimson. Dorsal fin broadly black-banded on margin, yellowish-banded medially, and crimson at base. Colors of the caudal similar, without the crimson; inferior fins milky white.

Dimensions of an adult specimen:

	In.	Lin.		In.	Lin.
Total length.....	5	2	Depth at occiput.....	8	5
Length muzzle and chin. ....		4.5	“ at dorsal. ....	1	
Diameter orbit .....		3.75	“ at caudal peduncle..	5	25

This species is only second to the *H. cornutus* in size, and first in the genus in beauty. Its particolored fins and crimson cheek stripe render it easily recognizable. The latter feature gives it its name. It occurs in abundance in the clear and often rapid creeks that flow into the north and middle forks of the Holston River in Virginia. Taken in the Ninth month.

#### *HYPSILEPIS GALACTURUS* Cope.

*Spec. nov.*

The general form of this fish is fusiform, the inferior and superior outlines converging equally. The superior cranial outline descends gently and equally; the muzzle is more than usually prolonged beyond the mouth. The end of the

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maxillary stands opposite the nares. The eye is smaller than in the other species, excepting *H. analostanus*, entering 5.5 times the length of the head in old specimens. The head enters the total (exclusive of caudal fin) 4.3 times, and the greatest depth 4.6 times. The exposed surfaces of the lateral scales are not so much narrowed as in the other species, and the lateral line is but little decurved; nos. 6—41—3; eighteen anterior to the dorsal fin. Small tubercles appear on the top of the head, the patch narrowed behind, and the sides of the muzzle. The pectoral fins reach three-fifths the distance to the ventrals, the latter the vent. The anal is larger than in most species, its outer margin as long as from end of muzzle to middle of operculum. Dorsal elevated, the height equalling depth of body at first anal ray in a male. Rays D I. 8. C+19+. AII. 9. V. 8. P. 14.

Dimensions of an adult:

	In.	Lin.		In.	Lin.
Total length .....	5	4	Depth at occiput.....	8	25
Length muzzle.....	3	75	“ dorsal.....	11	75
Diameter orbit .....	2	75	“ caudal peduncle.....	5	75

In life this species is steel gray above, and silver beneath; the inferior fins are milky, and the dorsal and caudal iron grey sprinkled with blackish. The hinder portion of the former has the membrane black and the rays cream colored, and the whole base of the caudal is cream yellow.

This fine species is abundant in the tributaries of the Holston River in Virginia. Many specimens are in the museum of the Academy.

It resembles the *H. analostanus* in its proportions of eye and head, but is more elongate in body. The largest specimens are more than twice the size of the largest of the latter.

*HYPHILEPIS ANALOSTANUS* (Girard) Cope.

*Leuciscus kentukiensis* Kirtl. Journ. Bost. Soc. Nat. Hist. V. p. 27 (not of Rafinesque). *Cyprinella* do. Cope, Proc. Acad. Phila. 1854, 279. *Hypsilepis* do. Cope, Trans. Am. Phila. Soc. 1866, 371. *Cyprinella analostana* Girard, Proc. Acad. Phila. 1859, 58. Cope l. c.

The dorsal and ventral outlines are regularly and gently arched from the end of the muzzle and contract to a caudal peduncle of about the depth of the head at the middle of the orbit. The dorsal region is quite compressed, the ventral narrow but not carinate in front of the vent. Eye round, contained 4.5 times in length of head, and 1.5 in length of muzzle; the latter is narrowed and projects slightly beyond the mouth, most so in males in breeding season. Oral margin arched, end of maxilla opposite middle of nares. The greatest depth of the body is greater than the length of the head, and enters the total (including caudal fin) four and one-fifth times. Tail short, deeply and concavely emarginate. Anal fin less developed than dorsal, its base nearly equal height of first ray, and just exceeding base of dorsal; latter a little over  $\frac{2}{3}$  greatest elevation of the same.

General color leaden silvery, darkest on the sides, the scales above and below, a dorsal band and large spot on hinder part of dorsal fin, blackish; top of head and median margin of anal fin shaded with the same. In spring and summer the inferior fins, and even the tips of the caudal and anterior part of the dorsal, are filled with a satin white pigment, which has a very elegant effect, and gives the fish its local name of “Silver Fin.” At the same period the head and muzzle of the male are studded with small tubercles, as follows: a conic accumulation on the end of the muzzle, prolonging it; a series round the mandible, also over the orbit, from an agglomeration on the preorbital bone; a double series of larger tubercles on each side the frontal region, which join between the nares and on the parietal region; scattered series on the temporal region.

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Total length 3.375 inches; caudal 5; from its base to first ray of anal 1 in.; to first dorsal ray 1.44 in.; from latter to end of muzzle 1.56 in.

This species is abundant in the various tributaries of the Ohio; it is also common in all the waters of the Susquehanna examined (Octoraro, Conestoga, Juniata, Meshoppen) and in the Potomac (Girard); from the Delaware I know it from the neighborhood of Trenton (C. C. Abbott) and Philadelphia (J. Burk), Conshehocken on the Schuylkill. From the James River, Va.

It is also abundant in the Kanawha and its tributaries, but is not known from the Holston. It is chiefly to be found in the quieter parts of river channels and back waters, being comparatively rare in creeks.

Dr. Girard described specimens of this species from the Potomac as distinct from those of the Ohio, without making comparisons. I undertook to substantiate the differences and gave the following as distinctive features of the Eastern and Western fishes:

Head  $3\frac{2}{3}$  to 4 times in length to base of tail. Scales  $\frac{5-(6)}{2-(3)}$ —32—5 for the Eastern.

Head  $4\frac{1}{3}$  times; muzzle more acute. Scales  $\frac{6-7}{3-4}$ —38—40 for the Ohio type.

These represent the tendencies of the individuals of these regions correctly, but the exceptions to the rule are not rare; thus a Schuylkill specimen before me exhibits a head  $4\frac{1}{3}$  times in length and has an acute muzzle, scales of lateral line 38. Seven rows of scales above the lateral line in a Youghiogheny specimen, include some abnormally intercalated, but not a true series; about half the Delaware specimens exhibit six. Four rows below the lateral line has resulted from counting an elevated abdominal series. In two Ohio specimens the anal radial formula is identical with that of the eastern, 1.9, while in five the formula is 1.8. Thus this species exhibits an unusual range of variation.

Dr. Kirtland identifies this species with the *Leuciscus (Luxilus) kentuckiensis* Rafinesque, but this cannot be correct, as the latter is described as having red fins, a characteristic always wanting in the *H. analostanus*.

#### HYPHILEPIS DIPLOEMIA Raf.

*Leuciscus diplœmia* Raf., Ichthyologia Opiensis, p. 50. *Luxilus* do. Kirtland, Bost. Journ. N. H. 1845, 276, Tab. *Plargyrus* do. Girard, Proc. Acad. Phila. 1856. *Hypsilepis* do. Cope, l. c. 1864.

This species has somewhat the form, as it has the coloration and minute nuptial excrescences of the species of *Clinostomus*; as in them, the dorsal fin commences slightly behind above the origin of the ventrals; its hinder margin is opposite the origin of the anal, to which the ventrals attain. Anal elongate, its last ray horizontal, outline behind, vertical concave. Dorsal elevated, rounded above, length of first articulated ray one-half from its base to base of caudal. Radial formula D I. 9 P. 12. V. 8. A I. 11. C. +18+. Dorsal outline elevated, superior line of cranium scarcely arched, head rather compressed; body rapidly narrowing to caudal peduncle at dorsal and anal fins. Caudal expanded, deeply emarginate.

In the breeding season minute asperities cover the dorsal line in front of the dorsal fin, and appear on the upper and lower aspects of the head. The latter are most abundant on the preorbital region; on frontal region sparse, minute. Rows on the superciliary and lower edge of suborbital regions, and two on each ramus mandibuli.

Length of head four times in length to base caudal, and less than depth of body. Scales of anterior dorsal region much smaller than those of the lateral; latter with exposed surfaces very narrow, and crested with minute tubercles in the breeding season.

Color, dusky above, the sides and belly silvery without band; below crimson

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in spring. A large black spot at base of dorsal fin. Length extends to four inches, according to Prof. Kirtland; of a specimen in Museum Academy, from Lansing, Michigan, 2 inches to origin caudal; 12.5 lines to origin dorsal; 6 lines to opercular margin; depth 7 lines.

Prof. Kirtland states that it is abundant in all western streams, and that it ascends rapids in shoals in spring for the purpose of depositing its eggs.

#### *HYPSILEPIS ARDENS* Cope.

Spec. nov.

Length of head 4.33 times in total; orbit equal muzzle, its anterior border reached by the end of the maxillary; mandibular symphysis projecting slightly beyond the end of the muzzle. About 26 rows of scales in front of dorsal fin. Anterior dorsal ray opposite the middle of the ventral, the posterior opposite the first anal. The first anal nearly as long as the longest dorsal, the fin elongate, concave behind; it is nearly reached by the ventrals. Pectorals extend half way to ventrals. Cranium slightly arched transversely above; inter-orbital space .25 greater than diameter of orbit. Opercular and preorbital bones deeper than long.

Dorsal region yellowish olive, the scales black edged to middle of sides, all rose shaded. Sides, belly and head rosy crimson, muzzle approaching vermilion; suborbital region purple. Dorsal and anal fins vermilion, the former black at base; pectorals and ventrals rose. Caudal orange red, black lined.

Length of largest specimen 3 in. 2.5 lines; to base dorsal 17.5 lines; latter to base caudal 14.5 lines. Depth at orbit 3.5 l.; at first anal ray 5.25 l.; at constriction caudal peduncle 3 l.

*Habitat*.—The head waters of the Roanoke River (in Montgomery Co., Virginia). One of the most richly colored fresh-water fishes.

#### *PHOTOGENIS* Cope.

Trans. Amer. Philos. Soc. 1866, 378.

This genus was established for species agreeing in general characters with *Hybopsis*, but resembling *Alburnellus* in dentition. The mouth is not small, the orbits and scales are large, and the form generally slender. The species frequent clear streams, are less common in swift rapids, and never occur in stagnant or muddy waters. They are ornamented with lustre almost exclusively, and do not develop conspicuous horny tubercles.

The present collection contains three new species of the genus, which are here added to the three already known:

A. Anal radii I. 10, in one species I. 9. (No black spot at origin of caudal fin.)

αα. Dorsal fin much nearer origin caudal than end of muzzle.

Scales (5) 6—39—40—3. Diameter eye equal length muzzle; 3.3 times in head; latter 4 to 4.5 in length; depth in same 5.6—5 times; above olive; sides silver, in a band on caudal peduncle. Anal radii I. 10..... *P. leucops*.

Frontal width three-fifths orbit. Scales 7—35—3. Orbit diameter greater than length muzzle, 2.75 times in head; depth 4.75 in length; lateral line much decurved; silvery below, fins unspotted. Anal radii I. 9..... *P. ariommus*.  
α. Dorsal fin equidistant between origin caudal and end muzzle.

Scales 4 (5)—36—40—3. Diameter of eye exceeding length of muzzle, 2.75 times in length of head; latter 4.5 in length,\* depth 5 times. Head above and edges dorsal scales blackish; sides and belly silver..... *P. telescopus*.

\* Always to origin caudal.

AA. Anal radii I. 8.

a. A black spot at origin caudal fin.

Scales 5—38—40—3. Orbit equal muzzle, 3·3—3·5 times in length head; latter 4·5 in length. Olive scales above brown edged; sides silver, with a purple band; muzzle and base dorsal red..... P. leuciodus.

aa. No black spot at base caudal.

Head narrower. Scales 6—38—2. Orbit less than length muzzle, 3·5 times in length head; latter times in total; depth five times in same. A leaden lateral band; middle caudal and spot on dorsal black..... P. spilopterus.

Head broad, frontal width equal diameter orbit, which is greater than length of muzzle, one-third length head. Scales 5—6—38—3. Head 3·75—4 times in length; depth 4—4·5 times..... P. scabriceps.

#### PHOTOGENIS LEUCOPS Cope.

L. c. *Squalius* (*Clinostomus*) *photogenis* Cope, Proc. Acad. Nat. Sci. Phila. 1864, 280.

A species resembling some *Alburni* in its large caducous scales and attenuated form. Eye over one-third head, round. Mouth quite oblique; under jaw scarcely projecting; maxillary not reaching line of margin of orbit. Head entering four and two-thirds times into length to fork of caudal; greatest depth seven times. Back broad. Fins D. narrow 8; C. 19, A. 1—10. V. little anterior to dorsal 9. P. narrow falcate 13, extending about half-way from their origin to that of the ventrals. Scales with radii stronger than concentric lines. From base of caudal to base of first dorsal ray, equal from latter to anterior border of iris. Lateral line deflexed, rising with outline of belly at anal fin. Above pale ochre, with a median brown line, and one on each side, from opercular upper angle to tail. Sides and below bright silvery, especially brilliant on the operculum and suborbital region. Lips blackish edged. Muzzle and chin whitish. Length three inches.

This species has but five scales above the lateral line as originally described, exceedingly rarely.

Three marked varieties of this species have come under my notice, as follows:

a. Depth greater, equal from end muzzle to middle of operculum; head usually 4·5 times in length. Numerous specimens from the Kanawha, especially from Sinking Creek and near Austinville, Wythe Co., Va.

aa. Depth less, six times in length, equal from end muzzle to edge preopercle; head four times in length. Two specimens from Youghiogheny, Pa.

aaa (P. l. *engraulinus*). Depth one-sixth of length, equal from end muzzle to between orbit and præoperculum. Head  $3\frac{3}{4}$  times in length. One specimen from Austinville, Wythe Co., Va., from a tributary of the Kanawha.

#### PHOTOGENIS ARIOMMUS Cope.

Trans. Am. Philos. Soc. Phila. 1866, 280.

This species resembles at first sight the *Ph. leucops*, but is less elongate. On comparing an example of the latter, .25 longer, the depth of the body is the same, and the eye strikingly larger; the depth of the head the same, and the muzzle shorter.

In this fish the operculum is deeply concave on its upper posterior margin, and the inferior is shorter than the anterior; in *P. leucops* the former is straight, and the inferior border equal the anterior. The dark lateral line is faint or wanting in the *ariomus*, and there is no black vertebral band. Placed alongside of a *Hypsilepis cornutus* of equal length, this fish is less

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deep, and has an eye of almost double the area, besides the different coloration and generic features of teeth and scales.

Eye two and three-fifths in length head; muzzle two-thirds its diameter; mouth large, mandible scarcely projecting, maxilla not attaining anterior margin of orbit. Frontal breadth three-fifths orbit. Pectoral fins reaching three-quarters distance to ventrals. Depth caudal peduncle one-third from middle origin caudal to opposite first anal ray. Basis of anal slightly elongate, four-fifths height of same, equal basis dorsal; latter equal two-thirds height of dorsal; last dorsal ray much less than half first, hence the outline of the fin is very oblique. Caudal deeply furcate, length equal that of head. Length from basis caudal to first dorsal ray equal from latter to above anterior part of orbit, as in *Ph. leucops*. Anal radii I. 9.

Light olivaceous sides and below silvery, becoming a band with superior dark edge on caudal peduncle. Sides of head and muzzle white.

Total length 2.875 inches; base of dorsal to superior base caudal 1.06 inches; same to end muzzle 1.19.

This species has only been found as yet in the White River, Indiana, by Wm. P. Clark, to whose attention I owe a single specimen.

*PHOTOGENIS TELESCOPUS* Cope, sp. nov.

A species combining an elongate form, short head and large eye, and nearly allied to the last described.

Mouth very oblique (angle 60°), mandible not projecting beyond premaxillary when closed; posterior margin maxillary on line of anterior margin of orbit. End of muzzle slightly decurved, profile above nearly plane; frontal region flat transversely, the parietal region gently convex in section. Lateral line slightly deflected. Posterior dorsal ray equal less than half the anterior, and equal the basis to the sixth ray. Basis of anal greater than that of dorsal, a little less than longest anal ray. Ventral fins fall short of vent, and are approached two-thirds the intervening distance by the pectorals. P. 14. D. and V. I. 8. C. + 19+. Length of an average specimen 3 in. 6.5 lines; end muzzle to first anal ray 1 in. 11.5 lines; depth caudal peduncle at posterior anal ray 3.75 lines.

In life this species is a pale sea-green, with distinct brown edges to the scales. Lateral lustre plumbeous posteriorly.

This species is very abundant in all the rapid streams tributary to the Holston River in Virginia. It is very rare in the river itself.

*PHOTOGENIS LEUCIODUS* Cope, sp. nov.

This species is allied to the *P. telescopus*, and may readily be confounded with it, but the more delicate tints at once distinguish it in life, and the smaller orbit strikes the eye on making comparison. As shown in the analytic table, the characters are numerous. It is the only one of the genus adorned with bright colors; they are subdued, the purple and silver of the sides resembling the nacre of some *Uniones*.

Muzzle rounded in profile, mandible not projecting, mouth oblique (30°), end of maxillary bone opposite margin orbit. Vertex gently convex transversely. Twelve scales in vertebral line anterior to dorsal fin. Lateral line nearly straight. Radial formula, except for anal, and lengths of fins as in the last species. Longest dorsal ray measures twice from its origin to above posterior margin or middle of orbit. End of muzzle and basis of dorsal fin red, as in the young of *Hypsilepis coccogenis*.

Total length of a fully grown specimen 3 in. 1 line; length to first anal ray 1. 8.5 lines. Depth caudal peduncle at last anal ray 3 lines.

This species is found in the tributaries of the Holston, in situations similar to those where the *P. telescopus* occurs. It is, compared with the last named, a rare fish. Numerous specimens in Mus. Academy.

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## PHOTOGENIS SPILOPTERUS Cope.

Trans. Amer. Philos. Soc. Phila. 1866, 280.

Form elongate, less so than in the *Ph. leucops*; scales with the radii distinct 6—10, and the concentric lines very strong. Lateral line deflexed anteriorly. Orbit three and one-half times in length of head, equal length muzzle, and is three-fourths the interorbital breadth. Head five and one-third times in total length, equal length caudal fin. Muzzle straight above, mandible not projecting when closed, end of maxillary attaining line of orbit. Premaxillary margin opposite middle pupil. Pectorals two-thirds length to ventrals. Bases of anal and dorsal fins equal, equal two-thirds height of former, three-fifths height of latter. First dorsal ray a little nearer origin caudal than end muzzle. Rays, D. 1.8. A. 1.8. V. 7 and 8. P. 13.

Length 2.875 inches, depth caudal peduncle at middle .19 in. Teeth in numerous specimens 1.4—4.1.

Color olivaceous, with a plumbeous band along the posterior half the lateral line; thoracic region and lower half the sides of head silvery, remainder of head blackish. Median part of caudal fin, a spot on the upper hinder portion of the dorsal, and a narrow vertebral line, black.

Many specimens of this species are in Museum Academy, from St. Josephs River, in southwestern Michigan.

This species bears a superficial resemblance to the *Hybopsis plumbeolus*, but apart from the difference of dentition, and the spot on the dorsal fin, this species has a smaller eye, longer ventrals, etc.

## PHOTOGENIS SCABRICEPS Cope, sp. nov.

This species is readily distinguished from its congeners by its stout robust form, heavy head, and large eye, and in life by minute rugosities which cover the front muzzle and chin, but which disappear, leaving no trace, in spirits.

Front and vertex flat, upper profile plane, end of muzzle obliquely descending. Mouth little oblique, mandible as long as muzzle; extremity of maxillary opposite line of orbit. The operculum is more posteriorly prolonged than in the *P. telescopus*. Lateral line distinctly deflexed. Pins small, pectorals and ventrals short; radii as in the last species.

This species is not so refulgent as most others of the genus. In life it is of a bright sea-green, with an ill-defined silver lateral band, which is leaden shaded on the caudal peduncle. Dorsal streak reddish, scarcely perceptible in alcohol.

Total length 3 in. 1.5 lines; width of cranium behind 4.2 lines; length of caudal fin (equal from end muzzle to preoperculum) 5.75 lines.

This species occurs abundantly in the tributaries of the Kanawha River, in company with the *Ph. leucops*, especially in Sinking Creek, Walker's Creek, and near Austinville. It occurs not rarely in the main channel of the river also.

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A Review of the species of the AMBLYSTOMIDÆ.

BY E. D. COPE.

This family is of particular interest among the Urodela, as furnishing connecting forms between the ordinary types of the order, and those larger species which we suppose to be more characteristic of former periods of the earth's history. It also furnishes us with transitional conditions of characters which have been regarded as indicating very diverse origin and nature. The species are mostly of large size, and are probably confined to North America; perhaps a species exists in Japan.

The characters which restrict the family are as follows:

Palatine bones not prolonged over parasphenoid, bearing teeth on their posterior margins.

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